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USSR Report

ENERGY

(FOUO 5/82)

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ELECTRIC POWER

KURPSAYSKAYA GES DESIGN, CONSTRUCTION REPORT

Moscow GIDROTEKHNICHESKOYE STROITEL'STVO in Russian No 11, 1981 pp 8-13

/Article by Yu.P. Kornev, engineer: "The Kurpsayskaya GES on the Naryn River"/

/Text/ The Kurpsayskaya GES is located on the Naryn River in the Kirghiz SSR and is a part of the cascade of the Nizhnenarynskiy hydroelectric power stations. Being the second stage of the cascade, the Kurpsayskaya GES will operate in the runoff of the Naryn River, which is regulated by the reservoir of the Toktogul'skaya GES with a useful capacity of 14 cubic kilometers, which provides for the regulation of the runoff over a span of several years.

The Kurpsayskaya GES is to cover the loads and ensure a reserve within the Central Asian Unified Power System in a regime ranging from the base (summer) to the peak (winter).

In designing the Kurpsayskaya GES special attention was given to incorporating the advantages of cascade construction, primarily by making maximum use of the production base of the Toktogul'skaya GES as well as the reliability and economicalness of the dam of the Kurpsayskaya GES.

Technical-economic indicators of the Kurpsayskaya GES:

NPU mark, in meters	124.0
Full reservoir capacity, millions of cubic meters	370.0
Usable capacity of the reservoir for generating electricity, in millions of cubic meters	35.0
Estimated expenditure of the GES, cubic meters per second	972.0
Head, in meters:	
Maximum	101.0
Estimated	91.5
Maximum (when Q = 1800 cubic meters per second	88.0
Rated capacity, thousands of kilovolts	800.0

Average electric power output over a period of years, in millions of kilowatt-hours	2630.0
Number of hours of use of rated capacity, in hours	3280
Capital investments, in millions of rubles	181.16
Annual outlays, in millions of rubles	3.41
Relative capital investments, in rubles:	
Per kilovolt of rated capacity	226.0
Per kilowatt-hour of generated electricity	6.9
Production cost of electric power, kopecks per kilowatt-hour	.130
Number of years to recover investments	(less than year)
Basic amounts of work for the power facility:	
Excavation of earth, thousands of cubic meters	1650
Mounding of earth, thousands of cubic meters	387.0
Concrete and reinforced concrete, thousands of cubic meters	1084.0
Metal structures and underground mechanisms, tons	7217.0
Equipment, tons	8925.0

Natural conditions. The runoff of the Naryn River and its main tributaries are formed in the central Tyan'Shan Mountains by the melting of snow and ice in the high mountains. The average outlay over a period of several years in the section of the Kurpsayskaya GES for general needs is 391 cubic meters per second; and the average runoff over a period of several years is 12,373,000 cubic meters.

The climate in the vicinity of the Kurpsayskaya GES is strictly continental. The average annual air temperature is plus 12.8 degrees C; the minimal temperature is minus 30 degrees C and the maximum is 44 degrees C; the average duration of the frost free period is 220 days and the annual precipitation is 378 mm.

The constant runoff for the Kurpsayskiy reservoir is insignificant and will be formed by an insignificant lateral influx.

Engineering and geological conditions. The length of the river in the section of the hydrosystem has the shape of a deep symmetrical V-shaped canyon with individual widenings in the places were the lateral tributaries feed into the river. In the section can be found the basic structures are, the sides of canyon rise above the river bed to 180 - 380 meters. The grade of the slopes is 25 - 40 degrees.

To the north of the hydrosystem's sector at a distance of approximately 60 kilometers the Talasso-Ferganskiy regional fault passes. Toward the area of this fault are confined the epicenters of several strong earthquakes of recent times. The construction site of the Kurpsayskiy hydrosystem for a length of 8 kilometers sits within a seismically quiet structural-tectonic area of a class II, restricted from the north by the deep Kyz-Kurganskiy fault and from the south by the deep Karasuyskiy fault.

This area is included within a 9-point zone of seismic activity. The basic rock formations within the sector of the main facilities are represented as an interstratified flysch rock mass of sandstones and argillites, the strata of which intersect the valley almost in half, with a drop toward the upper water race at an angle of 50 to 65 degrees.

In the section of the main facilities the basic rock formations are broken down into small lumps by several systems of fractures. According to the lithologic composition of the rock formations and the degree of fracturing within the massif there are strong and weak sectors. Among the weak sectors are the layers which are folded by thin-bedded argillites with layers of thin-bedded sandstones, the areas affected by the tectonic fissures of class IV and V and rock formations within the centers of the folds. In the contour of the trench of the dam the weak sections comprise nearly 20 percent of the area. In the river channel the capacity of the alluvial pebble bed does not exceed one to two meters.

The rock formations in the location of the section differ in their high strength in the specimen independent of the zone and groups of preservation. The temporary resistance to compression in air for the sandstones is 145.5 MPa on the average and for the argillites it is 76.2 MPa; in a water saturated condition these figures are 114 and 5[illegible].7 MPa, respectively.

In designing the dam the following indicators for resistance to shift and deformation characteristics were used: $tg\phi=.9$ and $C=.3$ MPa, $E_{def}=2000$ MPa and $E_{din}= 8000$ MPa, which were obtained by carrying out a set of field research by the department of geology of Sredazgidroproyekt /Central Asian State Institute for the Planning of Hydroelectric Power Stations/ and the department of rock excavation work of the Gidroproyekt /State Institute for the Planning of Hydroelectric Power Stations/.

The water permeability of the massif is dissimilar; the water absorption changes from thousands of particles to several liters per minute; there is no noticeable loss at depth.

Basic facilities of the hydrosystem: In the natural and construction conditions of the Kurpsayskiy hydrosystem the most logical variation was one having a concrete gravity dam for the following reasosn:

1. A gravity dam is little affected by the low-module foundation, which has been weakened by layers of argillites.

2. Within the body of a gravity dam are positioned the spillway facilities and also the facilities of the discharge station complex, which provides a substantial reduction in the cost as compared with other versions in which these facilities are installed individually in the sides of the gorge.

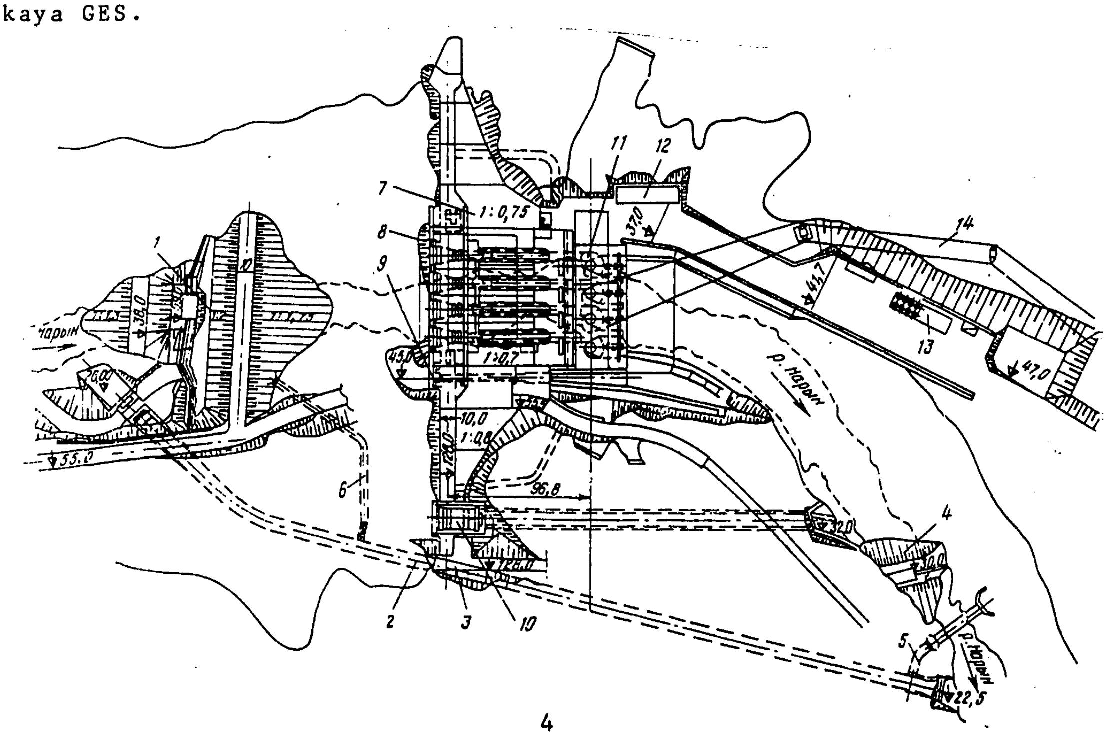
3. The high reliability of gravity dams that are constructed in seismically dangerous regions. (2) Also, the requirements placed upon the concrete of gravity dams are lower than for the material used in arched dams. This creates favorable conditions for the rational use of the concrete pouring operation of the Toktogul'skaya GES and a reduction in the amount of time required for the construction of the Kurpsayskaya GES.

4. The complete and efficient use of the Toktogul'kiy continuous-cycle method, which is highly mechanized, for pouring concrete and for its further improvement at the Kurpsayskaya GES with its version of a hydrosystem with a gravity dam.

The construction organization possesses a progressive and effective technology for the construction of gravity dams and has the needed equipment.

The layout of the basic facilities of the hydrosystem represents a complex of facilities that are almost interconnected with the dam. The hydrosystem's facilities include: a concrete gravity dam, surface and deep spillways, a complex of GES facilities with the station building attached to the dam as shown in Figure 1, and an open distribution device (ORU) of 220 and 110 kv.

Figure 1. Schematic diagram plan for the construction of the Kurpsayskaya GES.



Key: 1 - Upper coffer; 2 - Construction tunnel; 3 - Concrete plug; 4 - Lower coffer; 5 - Approach entrance No 1; 6 - Approach entrance No 2; 7 - Dam; 8 - Water intake; 9 - Deep spillway; 10 - Surface spillway; 11 - GES building; 12- Administration building; 13 - Lubricants storage; 14 - VL 220.

The dam. The gravity dam has a maximum construction height of 113 meters with a triangular profile with a small influx toward the upper water race below the 33 mark in order to approximate the cementation screen and drainage toward the header front. The header face of the dam is vertical, the laying of the lower face for the bed sections is m =.7, for the side sections m = .75 + .8. The length of the dam is 364 meters along the crest. The dam is broken down into 13 sections by the temperature-shrinking seams: two river bed sections with a width of 19.5 M (according to the amount of the aggregate assembly); two river bed sections and coastal sections with a width of 30 M with an additional breakdown of sections by seams on the upper and lower faces.

According to the geometry of the canyon (relation - L/H = 3) the dam is designed by taking into consideration the spatial effect, i.e. transferring part of the stress to the sides. The interaction of the neighboring sections is provided by a system of vertical toothings in the deformation seams.

The foundation of the dam in the river bed sections at the mark of its footing is horizontal. The foundation of the coastal sections in the direction of the axis of the dam is executed by several sloped surfaces with a placement varying from m = .5 to 1.6. In addition, to increase the rigidity on shift the foundation of the coastal sections have been inclined toward the upper water race.

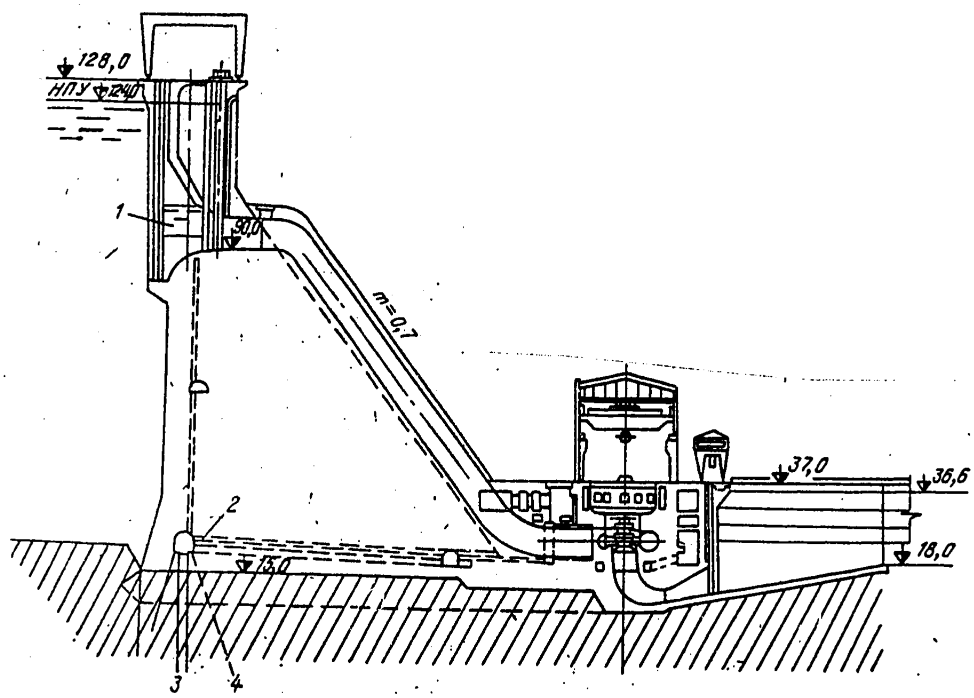
The drainage of the body of the dam is accomplished by using a system of vertical wells, which have been drilled in concrete made of poternes. The poternes are located on four layers (Figure 2).

In the design of the dam the following features have been incorporated:

a) the zonal distribution of concrete: the internal zone of the dam is made of concrete M-150_{180}V4_{180}; the external underwater zone and the zone that adjoins the cliff is made of concrete M-200_{180}V6_{180}; the summit and the lower face of the dam is made of concrete M-300_{180} MRZ 150; the outlets of the spillway facilities are made of concrete M-400_{180}. The concrete is prepared in cement TGTs-300 and TGPTs-300;

b) the use of ready-made reinforced concrete for the inter-sectional seams, drainage and cementation poternes, shafts and facilities for the pumping station;

Figure 2. Cross-section of dam and GES building by axis of the turbine water conduit.



Key: 1 - GES water intake; 2 - Poterne for the fastening cementation; 3 - Joining and depth cementation; 4 - Drainage.

c) design reinforcement of the contours of the openings and facilities, and also the upper portion of the head face (approximately 2/3 of height). The reinforcement of the head face has been done as a preventive measure, which makes it possible to concentrate fissures in the event that they develop and to limit their spread. The average expenditure of fittings per cubic meter of the body of the dam is 2.7 kg. The estimated reinforcement is required in the water intake of the GES, the deep spillway, and the cap of the surface spillway;

d) the elimination in the foundation of the dam of a layer of the cliff of intensive wind erosion; the strengthening cementation of the foundation of the dam; the anti-filtration frontal cementation; and the drainage screen.

The strengthening cementation is performed throughout the construction site to a depth of 10 meters. The double-layer frontal cementation in the river bed section is performed to a depth of 65 meters. In the lateral abutments, beneath the upper two thirds of the dam, frontal cementation is performed in a single row.

The spillway facilities of the hydrosystem. The hydrosystem's facilities include provision for surface and deep spillways, which together with the GES turbines ensure the passage through the hydrosystem of the maximum estimated expenditure - 3,680 cubic meters per second, which is taken as the sum of the maximum passage from the Toktogul'skiy reservoir - 3,000 cubic meters per second (1) and the maximum expenditure of lateral influx on the Toktogul-Kurpsay sector of one percent of the utilization, which is equal to 380 cubic meters per second.

The maximum expenditure is distributed among the facilities in the following manner: the surface spillway - 1,680; the deep spillway - 1,074; and the four assemblies of the GES - 972 cubic meters per second.

The division of the spillways makes it possible to have two independent outlets for the water, which increases the reliability of the hydrosystem on the whole.

The deep spillway is in the form of a single-aperture pipe measuring 5X7 meters and placed in the section of the dam that adjoins the power station building from the right side. At the outlet the pressure gallery is equipped with a flat emergency repair and regulating segmented gates measuring 6X5 meters, which are installed in a specially devised chamber of gates, which adjoins the lower face of the dam. The head is 80 meters. The spillway has a metal frame. The deep spillway is used to regulate the filling of the Kurpsayskiy reservoir during the period prior to the start-up of the GES's first section, for the passage of construction expenditures during the rigging of the plug in the construction tunnel, and also for the passage into the lower water race of the water expenditures for irrigation needs during the temporary operation of the GES when water levels are reduced.

The surface spillway handles a significant portion of the spillway runoff and is a simple to operate facility with a cap that is completely accesible for repairs and inspections. The surface spillway, just as the deep spillway, is located on the right-hand side of the shoreline and is adjacent to the side of the dam. The runoff with an inlet front of 16 meters has a smooth narrow section in a plane with the transit to the outlet tract with a width of 10 meters. A working segmented gate measuring 15X13 meters is installed on the runoff. The outlet tract of the surface spillway is an inclined tunnel, which is horizontal on the right side of the gorge. The joining of the outlet tract with the river bed is executed in the form of a funnel design with a jet-deflecting nozzle.

Facilities of the power station complex. These include the water intake, the turbine water conduits, the GES building. The water intake is of the deep type with a head of 44 meters and is situated on the upper face of the dam and consists of four sections by number of units in the GES building. The cleaning of the grating and the maneuvering of the repair gates is accomplished by a gantry crane from the summit of the dam with a lifting capacity of 2X100 tons. The water feed into the turbines is accomplished by four lines from the steel reinforced concrete pipelines, which have been relegated to the lower face of the dam beyond its profile. The eliminates inconvenience in the carrying out of work, which are connected with the removing of debris from the dam; the erection of the dam does not depend upon the installation of the pipelines.

The diameter of the pipelines is 7 meters. The steel reinforced concrete facing of the pipeline is accepted as a full dynamic head. The thickness of the reinforced concrete casing is one meter. The power station building with a single-row positioning of the four units adjoins the dam from the lower water way. The entire underwater massif is designed in the form of a single unit.

Inside the power station building are installed the type RO 115-810-V-500 units with a rated capacity of 200,000 kW each, in metallic spiral chambers with type VGS 1090-225-44 generators with a rated capacity of 200000/235 in an umbrella-like shape. The machinery room and the the installation area measure 20X114.5 and is served by two bridge electric cranes with a lifting capacity of 360 tons. The four type TTs-250000/220 power transformers are situated on supports on the side of the lower water way. In the lower water way of the power station building provision has been made for the grooves of the repair gates of suction pipes, which are serviced by gantry cranes with a lifting capacity of 50 tons. The administration building is located within the GES building site not far from it.

Passage of the construction outlays. The topographical conditions of the section predetermined the tunnel method for the passage of construction outlays (Figure 1). Included in the facilities for the passage of construction outlays are: the construction tunnel, and the upper and lower construction coffers. (3)

The estimated outlay of the construction period in the technical draft has been reduced to 1,800 cubic meters per second against the everyday outlay of one percent of the utilization of 2,980 cubic meters per second through the accumulation of a part of this outlay in the Toktogul'skiy reservoir.

In constructing the tunnel consideration was given to the fact that the Toktogul'skiy reservoir was not filled prior to the start of construction work on the Kurpsayskaya GES. This made it possible to reduce the estimated outlay of the construction period to 1,100 cubic meters per second and to decrease the sectioning of the tunnel.

Special features of organizing the construction. In developing the basic solutions for organizing the construction use was made of the favorable situation that had evolved following the completion of two power stations of the cascade of the lower stage (Uch-Kurganskaya GES No 1) and the upper stage (Toktogul'skaya GES) in this area. The construction materials industrial base that has been well established here is partly located in Shamaldysay and partly in Karakul. A settlement has been created for the builders; the population of this city reached 20,000 just prior to the start of the construction of the Kurpsayskaya GES.

Through the section of the construction passes a 110 kV high-voltage power transmission line. All incoming cargoes arrive at the Shamaldysay railroad station, from which it is delivered to the construction site by truck. Equipment weighing more than 60 tons comes to the unloading point for heavy cargo, from which it is trailered to the Kurpsayskaya GES.

At the construction site it is planned to create only sectional organizations with a reduced work program. The design calls for the use of the existing concrete and gravel organizations, which are located near the city of Karakul, which were built for the construction of the Toktogul'skaya GES. Prior to the start of the construction while carrying out the design work in the years 1972 through 1975, the NIS /Scientific-Research Construction Trust/ of Giproproyekt and the Sredazgidroproyekt and the Naryngidroenergostroy /Naryn River Hydroelectric Power Station Construction Trust/ performed research in production conditions on the possibility of transporting a concrete mixture over long distances in the conditions of the hot and dry climate without reducing the basic characteristics of the concrete mixture and the poured concrete.

The research fully confirmed the possibility of supplying the construction of the Kurpsayskaya GES with a concrete mixture from an existing concrete plant of the Toktogul'skaya GES. The estimates were based upon the possibility of erecting a concrete laying of the dam without pipe cooling.

The pouring of concrete for the dam just as the dam of the Toktogul'skaya GES is being done under the protection of a self-raising tent. The upper face is below the threshhold of the deep spillway and is protected from the outside effects of the temperature by a filling of earth and a fixed heated concrete form. The lower face is being concreted in a console concrete form, which is heated when it is cold. In the summer months on the lower face a water casing is created; in the winter a heat-reflecting drag is rigged below the concrete form, which shields the freshly-poured concrete from sharp drops in temperature. A special feature of the concrete work on this dam is the fact that as the horizontal construction seams are being prepared and the concrete is being poured from the lower unit, within the limits of the internal zone the cement film is not removed. This solution has been confirmed by research done by the VNIIG /All-Union Scientific Research Institute of Hydrotechnology/ imeni Vedeneyev with the participation of Sredazgidroproyekt.

The pouring and mixing of the concrete mixture are done by a concrete pouring equipment set: the "Naryn" dump truck, an electric bulldozer and an electric tractor with a package of IV-90 vibrators. The moist maintenance is employed with the poured concrete - in the summer months an intensive surface cooling is performed.

Basic stages of construction. The execution of a set of preparatory work in the construction of the Kurpsayskaya GES began in 1976. During the preparation period a 110 kV high-voltage power transmission line was extended from the area of the river sector, the sector administrative organizations at the construction site were built, the transportation and construction tunnels were built, and the construction coffers were built, etc. Simultaneously with the start of the construction work Sredazgidroproyekt and Naryngidroenergostroy developed an additional set of measures, which made it possible to reduce the amount of time required for the preparatory period and to speed up the construction of the basic facilities. The measures included the rejection of the cable-crane for pouring concrete, which eliminated the need to execute complicated and significant amount of rock excavation beneath the scaffolding of the cable crane above the trench of the dam; the partitioning of the surface and deep spillways; and a significant reduction in the amount of rock excavation in the contour of the trench of the dam.

Early in May 1978 the span over the Naryn River was completed and the by-pass of the outlays into the construction tunnel was completed. The upper construction coffer was constructed along with the build-up of the irrigation draw-downs from the Toktogul'skiy reservoir.

Combining the work on the laying of the construction tunnel and the development of the trench of the dam made it possible as early as the end of 1978 to completely finish the rock excavation in the contour of the trench and to pour the first cubic meter of concrete in the body of the dam.

The intensive pouring of concrete began in March 1979 with the arrival of warm weather. Concrete pouring began in earnest in the section of the dam with the deep spillway and the installation of the metal structures of the deep spillway. During 1979 215,000 cubic meters of concrete were poured into the body of the dam and 35,000 cubic meters went into the GES building. The average monthly growth in the height of the dam for the year was 2.5 meters. In 1980 the growth rates of the dam increased - approximately 300,000 cubic meters of concrete went into the body of the dam and another 50,000 cubic meters went into the GES building

At the start of 1981 the dam was approaching the start-up elevations. Concrete pouring was completed in the unit of the GES building with the installation site. The installation of the pipeline of the start unit was completed. Work was finished on securing the outlet channel of the GES. In the middle of January 1981 the concrete plug was installed in the construction tunnel and water expenditures were switched to the deep spillway: the Kurpsayskiy reservoir began to be filled.

Conclusions. 1. The composition of the facilities and the type of dam for the Kurpsayskiy hydrosystem were accepted in close coordination with the specific nature of cascade construction in mountainous rivers. Among the advantages of cascade construction in these conditions are: the possibility of using a ready production base with the technology already in place; the lack of the need to construct housing at the construction site; the construction is done by an organization having personnel who have had invaluable experience in concrete work during the construction of the Toktogul'skaya GES.

The realization of these advantages made it possible to sharply reduce the time periods for the preparatory work and to speed up the creation of the hydrosystem within a minimum of three to four years.

2. The gravity dam of the Kurpsayskaya GES was designed for a specific technology of its construction (the Toktogul'skiy method). The design of the dam is distinctive for its economicalness of profile and its high technological effectiveness. In the body of the dam one spillway facility has been abandoned - the deep spillway and the pipelines have been placed outside the limits of the profile of the dam to its lower face; the design of the seals of the deformation seams has been substantially simplified; the network of drainage poternes has been reduced in height; the pumping station for the drainage system has been placed outside the profile of the dam; facilities within the body of the dam, including stairwells and elevator shafts, have been reduced to a minimum.

Since the Toktogul'skiy method makes it possible to make good use of the possibility of zonal distribution of concrete, materials are being economically used in the Kurpsayskaya GES dam - the expenditure of cement in the concrete of the internal zone for grade 150 has been reduced to 180 kg per cubic meter of concrete.

3. During the construction of the Kurpsayskaya GES the technology for using concrete in single-layer applications from the upper to the lower faces of the dam was significantly improved. Among the measures taken which simplify the process of using concrete the following should be noted: the rejection of the use of pipe cooling of the body of the dam; the use of an almost un-cooled concrete mixture with a temperature in the summer time up to plus 24 degrees C; the automation of the thickening of the concrete mixture; and the rejection of the procedure of removing the cement film from the horizontal construction seams in the internal zone of the dam.

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FUELS

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SEARCHING FOR PETROLEUM ON THE SIBERIAN PLATFORM

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 11, Nov 81 (manuscript received 2 Jun 81) pp 1-5

[Article by F. G. Gurari (SNIIGGiMS): "Some Problems of Oil and Gas Prospecting and Exploration Activities on the Siberian Platform"]

[Text] The historic resolutions of the 26th CPSU Congress emphasize the enormous significance of the fuel and energy industry for further successful growth and development of the Soviet Union's economy. For this reason the congress decreed: "Secure accelerated development of activities pertaining to geological study of this country and increasing proved reserves of raw mineral resources, particularly fuel and energy resources. Take measures to discover oil and gas deposits in Western and Eastern Siberia...."

For the first time the Siberian Platform is named in resolutions issued by our country's highest party forum. This was fostered by the results of prospecting and exploration activities being conducted here, discovery of a number of oil and gas deposits, obtaining of commercial-quantity flows of hydrocarbons in many areas, and the rather favorable structural features of this vast region, which are becoming increasingly more clearly delineated. Forecast estimates of potential oil and gas resources calculated by scientific organizations constituted the basis for planning projects to initiate oil production and increase gas production in this region in coming years.

At the present time, however, prospecting and exploration activity on Siberian Platform has not been very effective. No large oil deposits, on which the beginning of oil production could be based, have been discovered, prospects for discovering such deposits in the next few years are not yet very clear, and proved reserves of natural gas are growing slowly. Influencing factors included the region's difficulty of access and harsh climate, as well as the slow increase in volume of deep drilling and geophysical exploration. The main factor, however, is the exceptionally complex geologic structure of practically all sedimentary complexes on the platform which are promising from the standpoint of oil and gas. The Siberian Platform is more complex than any of the other oil and gas regions of the USSR. For this reason prospecting and exploration methods should correspond to the character of the target structures. It is also essential that these exploration activities be fully equipped and thorough, with a high level of scientific processing and interpretation of obtained materials, and with scientific organizations highly responsible for their forecast estimates and recommendations.

Up to the present time the most promising zones and areas and the most probable productive sedimentary complexes have been fairly easily determined within the boundaries of the platform. Directions of subsequent prospecting and exploration work and methods have been specified, and areas have been proposed for sinking wells on a priority basis. These materials, which are the result of the joint efforts of Siberian production organizations, Siberian and central scientific institutes, have been fairly fully examined in numerous articles [9, 10], and have been discussed in a recently published major monograph [3], and in a comprehensive program of geological exploration for oil and gas on the Siberian Platform, drawn up by a number of production and scientific organizations.

At the same time it seems important to discuss problems which are not yet attracting considerable attention but which may prove to be extremely important.

The first of these involves the geotemperature conditions of the Siberian Platform. The cryolithic zone, that is, the zone in which the rocks are at or below zero degrees Celsius during the entire year, covers more than 80 percent of the area in oil and gas promising regions. The base of the cryolithic zone extends as deep as 1500 meters, and over a fairly substantial area [3]. The meager data available indicate a highly complex structure of the cryolithic zone and great variability not only of geometry but composition as well. And yet it is absolutely essential to take this variability into consideration at all stages of the geological exploration process, including when mapping out the development of discovered oil and gas reservoirs. We [4] long ago pointed out the necessity of studying subsurface temperature conditions in prospecting for oil and gas on the Siberian Platform. P. I. Mel'nikov and his colleagues at the Institute of Permafrost Studies of the Siberian Department of the USSR Academy of Sciences discussed this subject in great detail at a conference on Siberian productive resources (Novosibirsk, 1980). They pointed to the existence in the cryolithic zone of abrupt changes in the physical properties even of lithologically uniform rocks during phase transitions of matter caused by seasonal freezing and thawing and the presence in the cryolithic zone of so-called cooled rocks at a temperature below zero degrees Celsius but containing liquid brines (kriopegi). Such nonuniformity of physical properties will unquestionably affect conditions of obtaining and interpreting geophysical exploration materials, particularly resistivity and seismic prospecting.

Unusually low temperatures in the productive zone, which run 6-13°C, for example, in the Srednebotuobinskaya area, and which do not exceed 10-15°C in the majority of other areas [1, 3], should affect the mobility of fluids and the quality of reservoirs. It is true that in the Srednebotuobinskoye field crude at the margin of the Botuobinskiy horizon is comparatively light (density 0.84-0.87 g/cm^3) and low-viscosity, with a low solidification point (-30°C). In the very complex conditions of the Siberian Platform, however, crudes with various parameters will undoubtedly be encountered, including those for which low temperatures may exert decisive influence on their ability to flow to the wellbore. Knowledge of geotemperature conditions is even more important for predicting the phase state of gaseous hydrocarbons. On the northwestern margin of the Vilyuysk structural depression -- the most promising area for prospecting for new gas deposits -- data indicate that some of the promising Mesozoic horizons may be situated in the zone of hydrate formation. Naturally a special method should be employed in locating and developing such deposits. There is reason to assume that hydrate formation in productive Riphean-Cambrian horizons also took place on the Nepsko-Botuobinskaya arch [1]. It is therefore absolutely essential to add geotemperature investigations to the mandatory aggregate of prospecting and exploration activities on the Siberian Platform. In order to conduct long-term observations it is essential to establish a fixed network of condition-monitoring boreholes of those in which drilling was completed with negative results. Production organizations should be provided with the necessary equipment, apparatus and methods instructions. A program of geotemperature studies extending over many years should be adopted. Such a program, drafted by Siberian production and scientific organizations of USSR Mingeo [Ministry of Geology], with the participation of other agencies, following examination and approval by RSFSR and USSR Mingeo, will become a mandatory document and will make it possible to obtain the necessary information in short order.

Elaboration of a detailed and paleontologically well substantiated stratigraphic diagram of Riphean-Lower Cambrian sediments, promising from the standpoint of finding oil and gas, is another, no less important problem. In spite of an extended period of study and a large number of wells drilled to and through these formations, their subdivision into lithologic-stratigraphic subunits and correlation of sections of pre-Usol'sk sediments reached by deep wells in the southern part of the Siberian Platform [12]. Up to the present time there is no well-substantiated and generally accepted scheme of correlation of productive sandstone beds in Riphean-Cambrian sediments on the Nepsko-Boruobinskaya arch. In the majority of discovered fields the productive sandstones bear their own names, derived from the field name [3, 9, 11]. The picture is even more complicated as regards correlation of carbonate reservoirs in the Wendian-Cambrian Kostinskaya and Platonovskaya series [3, 5]. For this reason it is impossible at the present time to construct with assurance paleogeographic maps for the time of accumulation of the reservoir horizons, and conclusions on their genesis and distribution are very difficult to reach. Consequently, prediction of the presence and quality of reservoirs in new, as yet undrilled areas is very unreliable.

The prevailing situation is connected to a significant degree with lessening of attention toward stratigraphic-paleontologic investigations in oil and gas promising areas of the Siberian Platform, as has already been stated in the press [8] and in resolutions adopted at a meeting of the regional geology section of the Scientific and Technical Council of USSR Mingeo (Leningrad, June 1976). The situation has changed little for the better in the last five years. Very disturbing is the fact that in many Siberian production and scientific organizations a great many experienced paleontologists and stratigraphers are ceasing their investigations as they reach retirement age, while a replacement generation has not yet been trained. Also disturbing is the fact that Siberian geological higher educational institutions are training practically no specialists in the field of stratigraphy and paleontology. It is quite obvious that future development of oil and gas prospecting and exploration activities on the Siberian Platform requires a reliable and highly detailed stratigraphic foundation. Therefore the status of paleontological-stratigraphic investigations in this region should become the focus of special concern on the part of officials of production and scientific organizations. Considerable attention should be devoted to the study of microphytolites, acritarchs and other groups of Wendian-Cambrian organisms, which are playing an increasingly important role in correlating geologic sections.

A third important problem is the study of pre-Cambrian, Paleozoic and Mesozoic reservoirs, especially those involving Riphean-Cambrian carbonate, frequently organic sequences. The very primary nature of such reservoirs determines multiple causality and a highly complex structure and distribution of interstices in these reservoirs.

The situation is aggravated by the great age of these sediments and the active tectonic conditions of the Siberian platform. During repeated successions of deep subsidences and no less active uplifts in many areas of the platform, subsurface thermobaric conditions have changed substantially, and large fault zones have developed, which could not help but affect the phase state and composition of the waters and gases saturating the reservoir horizons. Complex, often irreversible processes of dissolving or cementation of rocks, enlargement or decrease (to complete elimination) of interstices occurred in reservoirs. Considerably younger traprock, invading Lower Paleozoic sequences, exerted an enormous and highly diversified, depending on the concrete geologic situation, and as yet very little studied effect on reservoirs. Many investigators have already pointed to the highly complex structure of Riphean-Cambrian reservoirs, the interstices of which depend not so much on sedimentogenic primary conditions as on the manifestations of tectonic movements and diversified secondary processes [3, 5, 7, 11]. On the Siberian Platform not only carbonates but also terrigenous reservoirs, both Paleozoic and Mesozoic, are of complex structure. Therefore the overwhelming majority of hydrocarbon deposits are associated with combined structural-lithologic traps, whereby the lithologic factor is frequently dominant.

The patterns of occurrence in contemporary space and geologic time of the diversified and complex processes which formed reservoirs, their intensity and correlation with processes of hydrocarbon generation is just beginning to be clarified. The mechanisms stopping the migration of fluid have also been little studied. Successful resolution of these problems requires considerable amounts of lithologic investigations, performed in a skilled and qualified manner, employing the most advanced methods. The complexity of a structure determines the complexity and mandatory combined approach of the scheme of investigation [5, 6]. Unfortunately neither the number of lithologic teams of the Siberian PGO [expansion unknown] and scientific research institutes, nor laboratory facilities, especially in the PGO, are adequate to the difficulty of the problem. The 5th All-Union Conference on Reservoirs and Fluid Traps held in Novosibirsk in November 1980 noted a number of serious of deficiencies in investigation of the reservoir and trapping properties of rocks [13]. They apply in full measure to Siberian oil and gas exploration organizations. We should add that there are very few or no lithology teams in a number of Siberian PGO (for example, in the Yeniseyneftegazgeologiya PGO). Siberian scientific organizations, both of USSR Mingeo and the USSR Academy of Sciences, do not have adequate manpower and resources to perform the required very substantial volume of diversified and complex investigations. Nor do I believe that enlistment of Moscow and Leningrad scientific research institutes and higher educational institutions will fully resolve the problem. It is necessary to establish appropriate laboratories and qualified teams of lithology specialists in all PGO conducting oil and gas prospecting and exploration activities on the

Siberian Platform. And this must be done as quickly as possible, until the planned sharp increase in volume of deep drilling is fully accomplished.

Of course the problems which must be resolved on the Siberian Platform are not exhausted with the above enumeration. There are many additional problems in this area of geophysical exploration, organization and technology of deep drilling. As I am not competent in these matters, I shall not discuss them. I am convinced, however, that without serious efforts directed toward resolving the problems raised in this article we cannot substantially improve the effectiveness of prospecting and exploration activities. But this is urgently demanded by the tasks assigned by the party and government to those persons engaged in geologic exploration of the Siberian Platform -- this very promising but as yet little known region.

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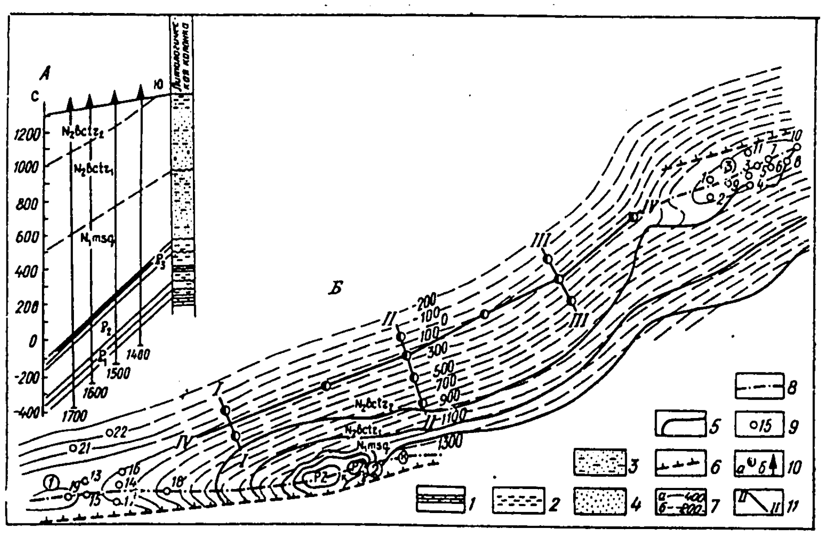
OIL, GAS PROSPECTING IN KIRGHIZ SSR

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 12, Nov 81 (manuscript received 6 Jul 81) pp 3-6

[Article by R. N. Khaimov, Yu. G. Pedder, R. A. Khodzhayev (SredAzNIPIneft'); E. G. Bazarbayev, Yu. F. Pekin, and G. I. Rudnev (Kirgizneft'): "Geological Exploration for Oil and Gas in the Kirghiz SSR in the 11th Five-Year Plan"]

[Text] Geological exploration activities in the search for oil and gas in the Kirghiz SSR are being conducted in two regions which differ in geologic structure -- the Fergana basin and Northern Kirghizia. Up to the present time 11 oil and gas pools have been discovered in the Kirghiz SSR. All of them are located in four structural zones of the Fergana basin. The Changyrtash, Suzak, Chigirchik, Beshkent-Togap, and Karagachi fields are situated on the Southern bench; the Maylisu-IV-Vostochnyy Izbaskent, Maylisu-III, Izbaskent, and Kyzyl-Alma on the Naryn; the Maylisay (with off-balancesheet oil reserves) -- on the Namangan. The Northern Karakchikum field is associated with the Central Fergana megasyncline. Three regional oil and gas complexes are distinguished in the Mesozoic-Cenozoic sediments of the Fergana basin: Paleogene -- for the most part oil-bearing; Cretaceous and Jurassic -- primarily gas-bearing. Commercial-category reserves in this region comprise only 32.4 percent of potential resources. Therefore in this area all conditions exist for increasing commercially-recoverable oil and gas reserves. In connection with this, the following areas of geological exploration activity are specified in the 11th Five-Year Plan for the Fergana part of the Kirghiz SSR: Jurassic sediments on the Naryn structural bench; Paleogene and Cretaceous sediments on the Central Fergana megasyncline; Paleogene (Karagunday structural prominence) and Mesozoic (Suzak-Chigirchik uplift zone) sediments of the Southern structural bench; Mesozoic sediments of the Naukat, Kurshab, and Uzgen troughs.

The main thrust of geological exploration by the Kirgizneft' Association in the 11th Five-Year Plan, providing the bulk of growth in oil, condensate and natural gas reserves, involves prospecting and exploration for oil and gas pools in Paleogene and Cretaceous sediments within the boundaries of the Karatau structural prominence, situated in the southwestern part of the Fergana basin. A number of oil and oil-gas fields have already been discovered in this region (Karagachi, Beshkent-Togap). Oil seeps associated with outcrops of Paleogene sedimentary rocks at the heart of the Karatau structural prominence suggest that its plunge from the Togap field on the west to the Aksaray gas field on the east is a highly promising zone. Structural-profile drilling (see figure) is recommended for studying the geologic structure and oil and gas prospects of Paleogene sediments in this zone (Beshkent-Togap-Aksaray). A second highly promising zone for oil and gas is the area adjacent to the Tuzluk fault and including the Western Tuzluk and Central Tuzluk structures and the southwestern part of the Northern Karakchikum uplift. In this area it is planned to conduct activities preliminary to deep drilling into the Yuzhno-Proletarskaya structure. The bulk (more than 60 percent) of exploration drilling will be concentrated in these two zones in 1981-1985, and a substantial increase in oil, condensate and gas reserves is anticipated. Characteristic of Paleogene oil reservoirs of the Karatau prominence (beds III-IV) is their occurrence within the boundaries of a narrow (1-2 km) strip in the crest-adjacent part of the northern flanks of the structures. This is due to the lithologic variability and worsening of the reservoir properties of the productive horizons toward the fold crests. Local erosion of productive formations is noted in the crest of some structures (Beshkent, Well 13). Oil traps in the Karagachi and Beshkent-Togap fields are of the anticlinal, unconformity and pinchout types. They are characterized by an insignificant content of dissolved gas in the crude (Togap 4-5, Beshkent 8, Karagachi to 26 m^3/t).



Geologic Section (A) and Structural Map of the Top of Horizon VII of Cenozoic Alayskiy Beds (B)

Key:

1. Limestones
2. Clays
3. Siltstones
4. Sands and sandstones
5. Geologic boundaries
6. Dislocations
7. Contour lines at top of horizon VII of Paleogene Alayskiy beds, M: a -- definite, b -- assumed
8. Axes of anticlines
9. Drilled wells
10. Planned wells: a -- on structural map, b -- on geologic section
11. Lines of planned profiles

Structures (circled numbers):
1 -- Togap; 2 -- Tashravat;
3. Aksaray

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Anticipated effectiveness of geological exploration by the Kirgizneft' Association in the 11th Five-Year Plan remains unchanged. But effectiveness greater than that achieved is planned for the principal area, that is, within the boundaries of the Karatau prominence and the Tuzluk fault.

As of 1 January 1981 the Kirgizneft' Association had seven structures with preliminaries completed for deep drilling. Six of these were in the Fergana basin and one in the Eastern Chu basin. In order to ensure a stable planned annual growth in oil and gas reserves, deep drilling must be conducted in the five-year plan on 14 new structures, preliminaries on which are to be performed by the Kirghiz Combined Expedition (KKGZ).

The Karatau and Karagunday structural prominences are primary areas for readying new structures for deep drilling. In the areas of the Eastern Fergana, however (the Naukat, Kurshab, and Uzgen troughs), practically no preparatory prospecting and exploration work has been conducted. Therefore plans call for intensification of geophysical exploration, with the aim of establishing a backlog of structures ready for drilling. In 1981-1985 the Kirgizneft' Association plans to prepare two areas -- Tamchi and Tashravat -- with structural drilling. Regional geophysical (seismic) exploration is to be conducted in a substantial amount within the Fergana basin. Such activities will be conducted within the boundaries of the Kurshab-Uzgen and Naukat troughs and the Achisu structural prominence. Detailed geophysical exploration is to be conducted within the boundaries of the Karatau, Karagunday and Maylisu structural prominences, where the discovery of non-anticlinal oil and gas traps is possible.

Regional and detailed geophysical exploration has been conducted in the basins of Northern Kirghizia since the middle of the 1950's, and deep parametric and exploratory drilling since 1960. Up to the present time 33 deep wells, totaling approximately 115,000 meters, have been drilled in the Eastern Chu, Issyk-Kul, and Naryn basins. In spite of a considerable amount of geophysical and drilling activities, no commercially-significant oil or gas pools have been established in the basins of Northern Kirghizia. Negative results from deep drilling, however, are no proof of absense of commerical quantities of oil and gas. As an example we might note that the presence of oil and gas in the Amu Darya structural depression was finally proven by obtaining a commercial-quantity flow of gas in the Setalan-Tepe area in April 1953, by the 113th deep well drilled in this area. Analysis of drilling in the basins of Northern Kirghizia indicates that practically none of the 17 areas in which drilling was begun met the requirements imposed on structures with completed preliminary work. Deep wells were drilled on an insufficiently reliably structural basis. Geophysical structures were not confirmed by drilling either as regards depths of reference horizons or morphology of structural forms. The reason for the sharp discrepancy between geophysical and drilling data is the low degree of effectiveness of seismic exploration by the correlation method of refracted waves and the reflected wave method, due to the complex seismogeologic conditions of the region. Deep drilling produced additional data confirming the possibility of finding oil and gas in Paleozoic and Cenozoic sediments in Northern Kirghizia. The extensive occurrence of Cenozoic lacustrine rocks, which may be oil and gas productive, has been established in the interior parts of the basins. An important substantiation of the possibility of oil and gas formation in lacustrine sediments is the discovery in recent years of oil pools in the basins of Northwestern China. Drill cores from Cenozoic and Paleozoic rocks in the basins of Northern Kirghizia show significant (up to 0.2-0.5 percent) concentrations of A bitumen. One frequently encounters dissolved gas with a methane content up to 42 percent in formation waters of Paleozoic and Cenozoic sediments. The Cenozoic and Paleozoic sections contain reservoir beds and enclosing impermeable rocks; porosity of the sandstones is as much as 20 percent. These data attest to the advisability of continuing geologic exploration for oil and gas in the basins of Northern Kirghizia. At the present stage of investigation of this area, a primary task, accomplishment of which will determine success in future exploration, is development of a qualitatively new prospecting method and preliminary work on structures by geological-geophysical methods. In the complex seimogeologic conditions of this region, more reliable data on deep structure can be obtained as a result of conducting seismic prospecting by the MOGT [expansion unknown] method, together with parametric and structural drilling. With the objective of developing a new method of identifying and performing preliminary work on structures, drilling of two or three parametric boreholes, with a total footage of 10,000 meters, is planned for 1981-1985 in the basins of Northern Kirghizia. From two to three MOGT seismic profiles are to be worked up in the 11th Five-Year Plan in the Serafimovskaya and Sukhokhrebtinsko-Tasminskaya areas, which are the most thoroughly studied by geophysical exploration and drilling. Comparison of the obtained results with the data of previously conducted geophysical exploration and deep drilling will help us more reliably evaluate the capabilities of MOGT seismic prospecting in finding and performing preliminary work on structures in the basins of Northern Kirghizia.

We must state the following regarding the overall problem of occurrence of oil and gas in Paleozoic sediments in Central Asia. The debate over this question has been going on for 50 years now. Some investigators continue to consider them unpromising in regard to finding commercial-quantity accumulations of oil and gas; others, on the contrary, place certain hopes in this regard on pre-Mesozoic formations. While the debate has been running on for years on the pages of the press, more and more facts are appearing which speak in favor of Paleozoic oil in Central Asia. These include not only already discovered purely gas pools of various size with nitrogen-helium (Ucharal-Kampyrtyubinsk, Pridorozhnoye and others in the Chu-Sarysu depression) and methane (Gugurtli, Ortalyk, etc) gas composition, but also commercial-quantity and close to commercial-quantity accumulations of oil occurring in these sediments (Boston and Alash in the Fergana basin, Kara-Kuduk on the Ust Urt, etc). In addition, investigations by A. M. Akhramkhodzhayev have proven the secondary nature of hydrocarbon fluids in terrigenous (sandstones) Lower-Middle Jurassic sediments of the Ust Urt, which migrated there from the underlying Paleozoic carbonate sediments. Therefore in our opinion one should approach the study of Paleozoic sediments of Central Asia from the standpoint of the possible existence of a new, completely uninvestgated oil and gas complex. It is necessary to conduct both regional (including orientation and parametric drilling, as well as high-quality geophysical exploration) and, subsequently, detailed geologic exploration, with step-by-step study of the material composition of Paleozoic rocks, history of the region's geologic development, and the existence of oil-producing formations in these sediments, identifying possible zones of origin and accumulation of hydrocarbon fluids, as well as areas with a possible concentration of secondary accumulations caused by flow of hydrocarbons from adjacent, hypsometrically lower productive Tertiary and Mesozoic sediments. Only purposeful oil and gas exploration activities focused on the Paleozoic sediments of Central Asia will furnish an unambiguous answer to this question.

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OIL, GAS EXTRACTION IN CASPIAN

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 12, Nov 81 (manuscript received 16 Feb 81) pp 6-11

[Article by Kh. B. Yusufzade (Kaspmorneftegazprom): "Results of Exploration Activities in the 10th Five-Year Plan and Development Prospects for Offshore Oil and Gas Production in the 11th Five-Year Plan in the Caspian Sea"]

[Text] Fourteen oil and gas fields with various geologic and production features were being operated in the Caspian Sea in the 10th Five-Year Plan. Ten of these (Artema Island, b. Darvina, Zhiloy Island, Gryazevaya Sopka, Ńeftyanyye Kamni, Peschanyy-more, Sangachaly-more-Duvannyye-more-Bulla Island, Bakhar, Yuzhnaya, Bulla-more) were in full-scale production, while four (b. Zhdanova, b. Lam, b. Apsheronskaya, and imeni 28 April) were in experimental commercial production (Figure 1).

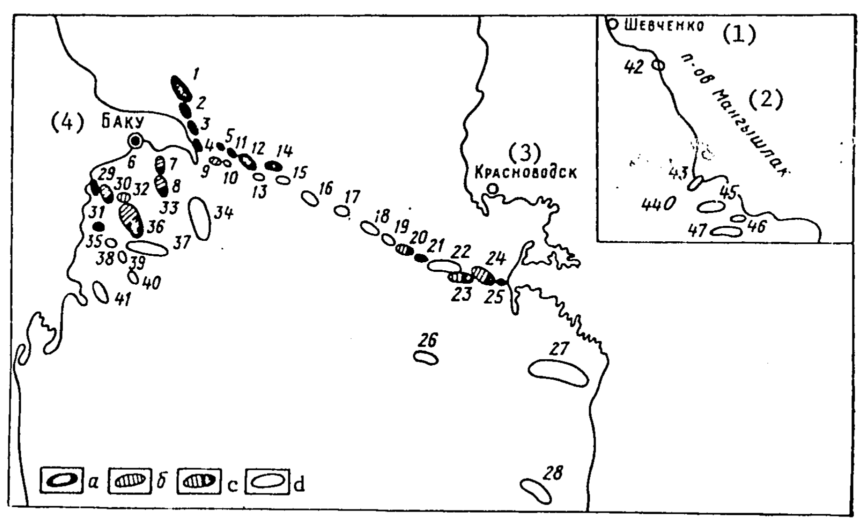


Figure 1. Schematic Map of Caspian Offshore Oil and Gas Fields

Fields: a -- oil; b -- gas; c -- oil and gas condensate; d -- structures under exploration

(Figure 1 on preceding page, cont'd)

Structures: 1 -- b. Apsheronskaya; 2 -- b. Darvina; 3 -- Artema Island; 4 -- Gyurgyany-more; 5 -- Zhiloy Island; 6 -- Lokbatan-more; 7 -- Peschanyy-more; 8 -- Bakhar; 9 -- Yuzhnaya; 10 -- Yuzhnaya-2; 11 -- imeni Azi-Aslanov; 12 -- Neftyanyye Kamni; 13 -- Neftyanyye Kamni-2; 14 -- imeni 28 April; 15 -- imeni Kaverochkin; 16 -- imeni 26 Baku Commissars; 17 -- Promezhutochnaya; 18 -- Lovanova-zapadnaya; 19 -- Livanova-tsentral'naya; 20 -- Livanova-vostochnaya; 21 -- imeni Barinov; 22 -- imeni Gubkin; 23 -- b. LAM; 24 -- b. Zhdanova; 25 -- Cheleken dome; 26 -- Zapadno-Ogurchinskaya; 27 -- Zapadno-Erdeklinskaya; 28 -- Zapadno-Okaremskaya; 29 -- Singachaly-more; 30 -- Duvannyy-more; 31 -- Alyaty-more; 32 -- Bulla Island; 33 -- imeni Samedov; 34 -- Shakhovo-more; 35 -- Garasu; 36 -- Bulla-more; 37 -- b. Andreyeva; 38 -- Kamen' Persiyanina; 39 -- Kamen' Ignatiya; 40 -- Kornilova-Pavlova; 41 -- b. Golovacheva; 42 -- Skalistaya; 43 -- Peschanomysskaya; 44 -- Peschanomysskaya-yuzhnaya; 45 -- Sarzha-more; 46 -- Zapadno-Rakushechnaya; 47 -- Rakushechnaya-more

Key:
1. Shevchenko
2. Mangyshlak Peninsula
3. Krasnovodsk
4. Baku

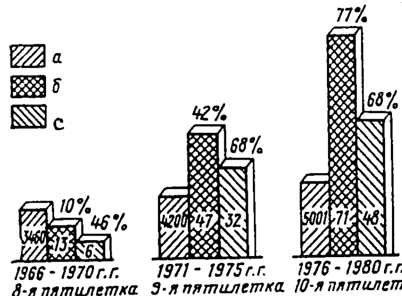
During this period oil and gas production in the above-named fields increased from 19.7 to 22.5 million tons. With a slight decline in the level of production of crude, natural gas production almost doubled. This was promoted by the discovery and development of new gas condensate fields and reservoirs, while crude oil production for the most part involved fields which have been in production for some time. All principal oilfields were producing with maintaining formation pressure. Extensive adoption of various systems and methods of water flooding promoted intensification of the exploitation process. For example, approximately 75 percent of total crude oil production came from formations being affected by water flooding. Water injection in the amount of more than 40,000 m^3/day made it possible to produce an additional 2.5 million tons of crude oil per year.

In addition to intensification of oil and gas field exploitation, considerable attention is devoted to adding proved reserves.

In the 10th Five-Year Plan offshore geologic exploration activities were conducted in the Azerbaijan, Turkmen, and Kazakh parts of the Caspian Sea. In conformity with the five-year plan for geologic exploration activities, deep exploratory drilling continued in the oilfield areas of the Apsheron-Pribalkhanskaya uplift zone and the Southern Turkmen shelf, primarily for the purpose of locating new and mapping previously discovered oil and gas pools in the Productive Sequence (PT) (Azerbaijan sector), the Middle Pliocene redbeds (Turkmen sector), as well as in the Kazakh part of the Caspian to determine the occurrence of oil and gas in Mesozoic sediments (see Figure 1). Deep exploratory drilling was being conducted in a total of 27 areas, including 18 in the Azerbaijani, 7 in the Turkmen, and 2 in the Kazakh parts of the Caspian. Four new oil and gas fields were discovered: the oilfield imeni 28 April, and the Yuzhnaya-2 gas condensate field in the Azerbaijan part of the sea, as well as oil and gas condensate fields -- the Cheleken dome and the field imeni Barinov in the Turkmen part of the Caspian. In addition, 6 oil and gas pools were discovered.

In 1975 the average depth of completed wells was 4590 meters, while the figure was 5250 meters in 1980. At the present time almost all wells begun in the Azerbaijan part of the Caspian have a planned drilling depth exceeding 5000 m.

In the 9th Five-Year Plan 42 percent of completed wells were deeper than 4500 m, while the figure was 77 percent in the 10th Five-Year Plan (Figure 2).



five-year plan

Figure 2. Diagrams of Principal Results of Geologic Exploration Activities, 1966-1980

a -- average depth of exploratory wells, m; number of wells with depth exceeding 4500 m: b -- completed wells; c -- producing crude or natural gas

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In 1980 Well 38, on the Bulla-more structure, produced from a depth of 6200 meters, a record depth for the world's offshore fields.

During the years of the 10th Five-Year Plan the following basic results of geologic exploration activities promoting the growth of oil and gas production were obtained.

The Apsheron Archipelago and western part of the Apsheron-Pribalkhanskaya uplift zone. The following oil and oil-gas condensate fields are in production here: Neftyanyye Kamni, Bakhar, Yuzhnaya, b. Darvina, Artema Island, Zhiloy Island, Gryazevaya Sopka, etc.

Offshore exploration activities were conducted in the following areas: Bakhar (simultaneously with development), Yuzhnaya-2, and imeni 28 April. In the Bakhar field the presence of oil and gas was discovered during the five-year plan in sediments of the "Discontinuity" formation, the Nadkirmakinskaya sandstone (NKP) and Podkirmakinskaya (PK) formations. In addition to wells 56 and 66, which established the presence of accumulations of oil and gas on the northeastern flank, Well 73, drilled in the central part of the fold, produced a flow of crude in excess of 400 t/day and gas at a rate exceeding 400,000 m^3/day.

The presence of gas in the NKP formation was established in the Yuzhnaya-2 area in 1976, when a flow of gas with condensate was obtained from Well 2 for the first time from the depth interval 4740-4690 meters, while a crude flow of 25-30 tons/day was obtained in 1978 from the Kalinskaya formation in Well 3.

Discovery of the Oilfield imeni 28 April was the most important result of Caspian exploration activities in recent years. During testing of producing zone 10 of the

PT Balakhanskaya formation in Well 4 in depth interval 3455-3423 m, a flow of crude was obtained, at a rate of 300 tons/day through a 9 mm connection, with P_{buf}=10 MPa. A second directional well was drilled from this same platform, Number 6, to determine presence of oil and gas in sediments down to and including the NKP formation. Due to problems with the wellbore, drillers reached only the upper part of the "Discontinuity" formation; testing in the depth interval 3483-3443 m produced crude oil with a flow of 300 t/day through a 10.5 mm connection, with P_{buf}=10.8 MPa. This signaled discovery of a new oil pool on this structure and confirmed that the field contained multiple pools.

Another well is scheduled to be drilled from the same platform, to a depth of 3950 meters, down to and including the NKP formation. In addition, 8 exploratory wells are to be drilled from 3 platforms and several wells from a semisubmersible drilling rig in 1981-1983 in order to estimate this field's oil and gas reserves.

In the 11th Five-Year Plan exploration is to be conducted in the promising Shakhovomore area of the Apsheron Archipelago, and a number of structures in the Apsheron-Pribalkhanskaya zone -- imeni Kaverochkin, imeni 26 Baku Commissars, and Promezhutochnaya. The propinquity of the latter to the Neftyanyye Kamni and imeni 28 April oil and gas fields certainly predetermines their oil and gas prospects. Exploration on these structures is to be conducted only with semisubmersible rigs, since the sea depth in the area exceeds 100 meters.

Considerable attention in this area will be devoted to continuation of work aimed at intensification of oil production in fields which are at a late stage of exploitation, the percentage share of which in total production volume will remain high. There is to be a further improvement of the water flooding system, with employment of various physicochemical methods, adjustment of exploitation by making the well grid denser, drilling of wells to residual crude and "pillars."

In spite of the fact that the Neftyanyye Kamni oilfield has accounted for a large part of total oil produced, this field has reserve potential for boosting production. In the 11th Five-Year Plan work is to continue on tapping pools for residual crude and "pillars."

Special attention will be devoted to pools with worsened geologic-physical and thermodynamic characteristics. Achieving a high oil yield from such reservoirs will require application of more sophisticated recovery methods. Pools maximum extraction of hydrocarbons from which should be accomplished with the employment of surfactants and micellar systems have been selected on the basis of existing criteria of applicability of physicochemical methods.

In the Bakhar field, in order to maintain a high rate of production in the 11th Five-Year Plan it will be necessary to resolve the complex problem of maintaining formation pressure. At the present time this is the only offshore vertically-stacked multiple-pool gas condensate field with an oil fringe where enhanced recovery methods will be employed.

The Baku Archipelago. In recent years, as the Sangachaly-more, Duvannyy-more, Bulla Island and Bulla-more fields have come into production, a new oil production area has been established in the Caspian, which in level approximates the fields of the Apsheron Archipelago. Exploration activities for the most part have been conducted in the above-named fields.

The oil pool margin in producing zone 7 and the gas pool margin in producing zone 8 on the northeastern limb of the structure have been expanded as a result of exploration conducted in the Duvannyy-more field. Well 547, which made it possible to extend the oil pool margin in producing zone 7, went into production after a flow of crude at a rate of 150 t/day was obtained from the depth interval 5351-5318 m through a 14 mm connection at p_{buf}=100 MPa. In view of the fact that on the northeastern limb of the fold zones 7 and 8 contain oil and gas, a number of wells were drilled on the southwestern limb (Bulla Island) in order to determine the occurrence of oil and gas at these horizons. Testing in the 5755-5721 meter interval in Well 554 (the deepest oil well) produced a flow of crude yielding 300 t/day through a 10 mm connection, with p_{buf}=10.5 MPa, and the existence of an oil pool was established in PT horizon 7 on the southwestern limb of Bulla Island. The latter was confirmed by Well 557, testing of which in the 5451-5427 meter depth interval (horizon 7) produced a gas flow of 700,000 m^3/day through an 11 mm connection, with p_{buf}=35 MPa, which attested to the presence of a gas cap in this pool.

In the 11th Five-Year Plan exploration activities will continue on mapping the oil pool in producing zones 5 and 7 and on prospecting for new reservoirs at PT horizon 8.

At another field in this archipelago -- Bulla-more, intensive work was conducted in the 10th Five-Year Plan on tracing oil and gas reservoirs in producing zones 7 and 5 and in locating reservoirs in zone 8 and the PK formation. The task of studying zone 8 and the PK formation is being accomplished by drilling wells in the crest-adjacent part of the structure.

The reservoir in producing zone 5, mapping of which was completed in the 10th Five-Year Plan, is of limited dimensions, and is a gas condensate pool with an insignificant oil fringe.

The high degree of gas saturation of zone 7 has been confirmed by testing data on 15 wells, where zone 7 lies at depths ranging from 5300 to 6200 meters in the investigated part of the structure.

In 1980, according to test figures on Well 38, which produces a natural flow of up to 700,000 m^3/day of gas and 200 tons/day of condensate, the gas surface in PT zone 7 was at a depth of -6172 m.

In the 11th Five-Year Plan mapping of the zone 7 pool is to continue, plus a search for pools at these levels (8 and PK formation), drilling wells to planned depths of 5600-6500 meters.

Exploration will continue in one of the promising areas of the Baku Archipelago -- b. Andreyeva, situated to the southeast of Bulla-more, where a well is presently being drilled, with a planned depth of 6500 meters, for the purpose of seeking oil and gas in PT zone 7. Plans call for drilling 6 or 7 exploration wells here to a depth of 6500 m.

There will also be further exploration in Bulla-more-2, established by seismic prospecting. The primary target here is zone 7, and a few wells will be drilled to commence study of PT zone 8.

In addition, the search for oil and gas reservoirs in the PT sequence is in progress in the Alyaty-more field. Drilling of individual wells is scheduled for the Kamen' Ignatiya, b. Kornilova-Pavlova, and b. Golovacheva areas.

Detailed geophysical, geochemical and other types of investigations are planned in connection with deep exploratory drilling to locate structures in this oil and gas field area.

In addition, in 1981-1985 plans call for continuing work on improving the system of development of the archipelago fields, production in which will continue to be substantial.

One of the factors which determine the magnitude of crude yield from producing formations in conditions of the complex-structured reservoir of the Sangachaly-more-Duvannyy-more-Bulla Island field is the ratio of viscosities of the crude and water in formation conditions and distribution of injected water vertically through the formation. In this field polymeric water flooding and dosing of surfactants into the injected water will be employed. Work will continue on regulating production by developing a denser well grid and by drilling standby wells as part of the planned reserve inventory. This will make it possible to achieve a high rate of crude production (4.5-4.6 percent) within the current five-year plan and, in addition to bringing into production pools in producing zone 8 and the PK formation in Bulla-more, to maintain the production level in the Baku Archipelago area.

Turkmen part of the Caspian Sea. In recent years the b. Zhdanova, LAM, Cheleken dome, b. Livanova-Vostochnaya and imeni Barinov fields have been discovered in this area. The first three are in experimental-commercial production. In these areas it is planned to continue exploration activities in order to map already discovered pools and to find new ones at deep horizons underlying the redbeds.

Prospects of discovering new oil and gas fields in this part of the Caspian are connected with continuation of exploration activities in the b. Gubkina area and initiation of deep exploratory drilling of such structures as Zapadno-Okaremskaya, Zapadno-Ogurchinskaya, Livanova-tsentral'naya, Livanova-zapadnaya, etc.

Bringing b. Zhdanova into commercial production, equipping the b. Livanova-vostochanaya and imeni Barinov fields with lines and equipment, alongside continuing exploration in these waters will make it possible to establish another oil production area here in the 11th Five-Year Plan.

In the Kazakh part of the Caspian exploration activities have been conducted on structures of the Mangyshlak Peninsula, the prospects of which are focused primarily in Permian-Triassic, Middle Jurassic, and Neocomian sediments.

The offshore continuation of the Beke-Bashkuduk arch has been investigated in detail by seismic methods, revealing a number of local structures. Structural boreholes as well as a few exploratory wells were drilled on some of them (Aralda-more, Zapadno-Rakushechnaya, Rakushechnaya-more) to gain more data.

In the 11th Five-Year Plan exploration activities are to continue on the Rakushechnaya-more and Zapadno-Rakushechnaya structures, with commencement of exploratory deep drilling in the Skalistaya, Inna-more, Sarzha-more, and Peschanomysskaya-more areas.

Regional geophysical exploration conducted up to the present time has established that the Northern Caspian offshore area contains the southern end of the pre-Cambrian Russian platform and the young Scythian-Turan platform. The presence of these geostructural elements, filled with Paleozoic and Mesozoic sediments, which contain commercial-quantity pools of oil and gas on adjacent onshore structures, attests to the good prospects of the offshore Northern Caspian, but this offshore area is a protected environment zone. In addition, a number of technical problems must be solved: development of the shallow-water areas, preventing pollution of the sea, etc. After this plans call for commencing geophysical exploration (including gravimetric, electrical resistance and seismic survey, signal-generator seismic exploration, airborne magnetic and geologic survey) for studying the deep structure, detailing the boundaries of large geotectonic elements, and identifying local structures within these large elements.

The principal geologic exploration activities, promoting the development of Caspian offshore oil and gas production, will emphasize these areas of investigation.

Bringing new fields into production and drilling of additional wells in existing fields, alongside improving the oil and gas field exploitation system, will make it possible to achieve the targeted growth and development of Caspian offshore oil and gas production in the 11th Five-Year Plan.

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BRIEFS

PALEOGEOMORPHOLOGICAL ATLAS--The USSR Academy of Sciences Institute of Geography and the Aerogeologiya Association of USSR Ministry of Geology announce publication in 1982 of an atlas entitled "Karty epokh regional'nykh kontinental'nykh pereryvov (paleogeomorfologicheskiy atlas SSSR)" [Maps of Epochs of Regional Continental Hiatuses (Paleogeomorphological Atlas of the USSR)]. Sixty maps. Approximate cost 6 rubles. These maps present for the first time comprehensive characteristics of paleotopography, sediments and exogenous commercial mineral deposits contemporary with the paleotopography, formation of which took place during various continental epochs of the Phanerozoic period. The atlas contains maps of the paleogeomorphological conditions of distribution of a number of commercial minerals (bauxites, oil, gas, etc). The maps are accompanied by an explanatory text. The atlas is intended for a broad group of specialists: geologists, geomorphologists, paleogeographers, lithologists, etc. It may also be of interest to teachers and students of geology and geography faculties. This atlas may be ordered from: 101890, Moscow, Krivokolennyy pereulok, 10, USSR Ministry of Geology "Geolkniga" specialized bookstore. [Text] [Moscow, GEOLOGIYA NEFTI I GAZA in Russian No 12, Nov 81 inside back cover] 3024

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